IS 15974 : 2013
(Superseding IS 12449 (Part 2) : 1988)

(Reaffirmed 2018)

भारतीय मानक

लैम्पों के सहायक चालन उपकरण (ग्लो स्टार्टर को छोड़कर) — कार्यकारिता अपेक्षाएँ

Indian Standard

AUXILIARIES FOR LAMPS STARTING DEVICES (OTHER THAN GLOW STARTERS) — PERFORMANCE REQUIREMENTS

ICS 91.140.90

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BUREAU OF INDIAN STANDARDS
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Electric Lamps and Their Auxiliaries Sectional Committee, ETD, 23

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers performance requirements for starting devices (starters and ignitors) for tubular fluorescent and other discharge lamps for use on a.c. supplies up to 1 000 V at 50 Hz, which produce starting pulses not greater than 5 kV.

'Safety requirements are covered in a separate standard IS 15885 (Part 2/Sec 1) : 2011 'Safety of lamp controlgear: Part 2 Particular requirements, Section 1 Starting devices (other than glow starters)'.

This standard supersedes IS 12449 (Part 2):1988 'Starting devices (other than glow starters): Part 2 Performance requirements'. After the publication of this standard, IS 12449 (Part 2) : 1988 shall be treated as withdrawn withdrawn.

Following changes have been incorporated in this standard with reference to IEC standard:

a) Cross references have been changed,
b) BIS certification marking clause has been added, and
c) Reference temperature changed to 27°C.

Assistance has been derived from IEC 60927 : 2004 'Auxiliaries for lamps—Starting devices (other than glow starters) — Performance requirements'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis , shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUXILIARIES FOR LAMPS STARTING DEVICES (OTHER THAN GLOW STARTERS) — PERFORMANCE REQUIREMENTS

SECTION 1 GENERAL REQUIREMENTS

1 SCOPE

This standard specifies performance requirements for starting devices (starters and ignitors) for tubular fluorescent and other discharge lamps for use on a c supplies up to 1 000 V at 50 Hz, which produce starting pulses not greater than 5 kV. It should be read in conjunction with IS 15885(Part 2/Sec 1) : 2011 'Safety of lamp controlgear : Part 2 Particular requirements, Section 1 Starting devices (other than glow starters)'.

NOTES

1 All glow starters for fluorescent and other discharge lamps including thermal relay/cut-outs will be included in IS 2215 : 2006 'Starters for fluorescent lamps (*third revision*)'.

2 Presently there are no standards regarding the national regulation of EMC requirements for end-products like luminaires and independent controlgear. In a luminaire, the controlgear is dominant in this respect. Compliance to the standards and/or regulation as and when available may be ensured for controlgear, together with other components.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent additions of these standards:

IS No.	*Title*
2215 : 2006	Starters for fluorescent lamps (*third revision*)
2418 (Part 2) : 1977	Tubular fluorescent lamps for general lighting service: Part 2 Standard lamp data sheets
10322 (Part 1) : 1985	Luminaire: Part 1 General and safety requirements
15687 (Part 2) : 2011	Single-capped fluorescent lamps: Part 2 Performance requirements
15882 : 2009	Ballasts for discharge lamps (excluding tubular fluorescent lamps): Performance requirements
15885 (Part 2/ Sec 1) : 2011	Safety of lamp controlgear: Part 2 Particular requirements, Section 1 starting devices collier than glow starters
15968 : 2011	Ballast for tubular lamps: Performance requirements

3 TERMINOLOGY

The definitions given in IS 15885 (Part 2/Sec 1) and the following shall apply.

3.1 Starter with Mechanical Switching Element — A starter which provides cathode pre-heating current and lamp starting pulse(s) by mechanical means (for example, thermal or magnetic).

3.2 Starter with Electronic Switching Element — A starter which provides cathode pre-heating current and lamp starting voltage(s) or pulse(s) by electronic means and contains no moving parts.

3.3 Deactivated Lamp — A lamp in which one or both cathodes are deprived of emitting material but neither of which is broken.

3.4 Non-re-operating Level — A reduced level of voltage and/or current at which a starting device must not re-operate after the completion of the starting cycle, and the lamp is operating normally.

3.5 Maximum Abnormal Current — The value of continuous r.m.s. current through the ballast which shall not be exceeded at the end of the starting cycle when the circuit is in an abnormal condition (for example, deactivated lamp, or lamp that has been removed).

3.6 Starting Aid — A starting aid can be either a conductive strip affixed to the outer surface of a lamp, or a conductive plate which is placed within an appropriate distance from a lamp.

A starting aid can only be effective when it has an adequate potential difference from one end of the lamp.

3.7 Maximum Case Temperature ($t_c + X$) Under Abnormal Conditions — Maximum allowable case temperature of the ignitor under abnormal conditions with metal halide lamps. The value of ($t_c + X$) is declared by the manufacturer.

4 GENERAL REQUIREMENTS FOR TESTS

4.1 General

Only requirements for type tests are included.

Unless otherwise specified, the tests shall be made at an ambient temperature between 10°C and 30°C.

The tests shall be carried out in the order of the clauses of this standard.

The following numbers of samples shall be submitted:

a) Six samples of starters as defined in **3.1** and 3.**2**; and
b) Four samples of ignitors (where appropriate, together with those circuit components which are necessary to carry out the tests).

4.2 Supply Voltage

The total harmonic content of the supply voltage shall not exceed 3 percent, the harmonic content being defined as the root-mean-square (r.m.s.) summation of the individual harmonic components, using the fundamental as 100 percent.

Care shall be taken that this applies under all conditions that occur during the measurement.

NOTE — This implies that the source of supply will have sufficient power and that the supply circuit has sufficiently low impedance at supply frequency and impulse frequency compared with the ballast impedance. The correct impedance at impulse frequency can be obtained by connecting a 2 μF (approximately) capacitor in parallel with the source.

4.3 All starting devices specified in this standard shall meet the requirements of IS 15885(Part 2/Sec 1).

4.4 All starting devices specified in this standard shall meet the requirements of IS 15885(Part 2/Sec 1).

NOTE — The requirements for starting devices are under consideration in IS 15885 (Part 2/Sec 1).

5 MARKING

The marking requirements of IS 15885(Part 2/Sec 1) shall apply, together with the following, to be either clearly marked on the starting device or made available in the manufacturer's catalogue, or the like:

a) Manufacturer shall declare the type of switching element as defined in **3.1**and **3.2**,
b) Manufacturer shall declare the maximum load capacitance for satisfactory operation of the ignitor, and
c) Manufacturer shall declare the allowable maximum case temperature under abnormal conditions ($t_c + X$) of the ignitor.

5.1 BIS Certification Marking

The ballasts may also be marked with the Standard Mark.

5.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made there under. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

SECTION 2 PERFORMANCE REQUIREMENTS FOR STARTERS (OTHER THAN GLOW STARTERS) FOR FLUORESCENT LAMPS

6 GENERAL

This section specifies performance requirements for starters other than glow starters, used with tubular fluorescent lamps with pre-heated cathodes, and their associated ballasts [s*ee* IS 2418 (Part 2) and IS 15687 (Part 2), where appropriate].

7 STARTING TEST

7.1 Starting Test Quantity

The starting test quantity consists of six new starters which have not been subjected to the tests specified in IS 15885 (Part 2/Sec 1).

7.2 Conditions of Acceptance

The prototype is considered as satisfying the requirements of this sub-clause, if all six starters comply with the appropriate tests specified in **7.4** to **7.8**. If one failure occurs, a further six starters shall be selected and tested and all these shall comply. If more than one failure occurs the starter is deemed not to satisfy the requirements of this clause.

7.3 Conditions of Test

7.3.1 *Circuit*

The starter is tested in the circuit as declared by the manufacturer.

A starting aid complying with the requirements of Table 1 shall be used unless otherwise indicated on the starter or in the manufacturer's literature.

In case of doubt a choice shall be made by mutual agreement between the testing authority and the manufacturer.

7.3.2 *Ballast*

The ballast used shall meet the requirements of IS 15968, where appropriate. It shall have a rated voltage equal to the supply voltage, or equal to the lowest value of the supply voltage range for which the starter is designed.

The rated wattage of the ballast shall be chosen to give the most onerous starting conditions of the range of lamp types for which the starter is designed. In case

Table 1 Starting Aid Requirements

(*Clause* 7.3.1)

Sl No. (1)	Lamp Diameter mm (2)	Starting Aid Width mm (3)	Spacing from Lamp mm (4)	Length (5)
i)	15	25	7	Not less than lamp length
ii)	25	40	12	
iii)	38	40	20	
iv)	15/25/38	1.5[1]	0[1]	

NOTE — A starting and spaced from the lamp can only be effective, if the outer surface of the lamp is treated to be net-wetting.

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[1] Strip affixed to lamp surface.

of doubt the rated wattage of the ballast shall correspond to the main lamp type for which the starter is designed.

Details of ballasts to be used for life testing are given in Annex A.

Where a starter is designed to operate with different ballast types (for example, capacitive or inductive), the tests are made with both types of ballast.

7.3.3 *Lamps*

The lamp shall be of the pre-heated cathode type and, where appropriate, meet the requirements of IS 2418 (Part 2). The rated wattage of the lamp shall be equal to the rated wattage of the ballast used.

For starters of the mechanical type defined in **3.1** the lamp shall normally be of the with starter type. For starters of the electronic type defined in **3.2** the lamp shall normally be of the starterless type. Where a choice of lamp of with starter or starterless type is declared by the manufacturer, the with starter type shall be used.

7.4 Starters Having a Mechanical Switching Element

7.4.1 *Speed of Operation*

a) *Current operated starters* — A current equal to the minimum pre-heating current prescribed on the relevant lamp data sheet in IS 2418 (Part 2) shall be passed through the circuit.

   For starters which incorporate a cut-out, the starter shall operate at least once during the test period of 30 s. For continuously operating starters, the starter shall operate at least twice during the test period of 30 s.

   The test is made with a deactivated lamp or with an equivalent resistance of both cathodes in series as prescribed on the relevant lamp data sheet in IS 2418 (Part 2).

b) *Voltage operated starters* — A voltage of 0.92 times the rated voltage of the ballast shall be applied to the circuit.

   For starters which incorporate a cut-out, the starter shall operate at least once during the test period of 30 s.

   For continuously operating starters, the starter shall operate at least twice during the test period of 30 s.

   The test is made with a deactivated lamp or with an equivalent resistance of both cathodes in series as prescribed on the relevant lamp data sheet in IS 2418 (Part 2).

7.4.2 *Cathode Pre-heating*

A voltage of 0.92 times the rated voltage of the ballast shall be applied to the circuit.

Starters shall provide sufficient lamp cathode heating. The pre-heating current shall be either as specified on the relevant lamp data sheet in IS 2418 (Part 2) or shall be in line with the lamp manufacturer's requirements relating to current and time.

7.4.3 *Pulse Voltage*

The circuit for measuring pulse voltage shall be as shown in Fig. 1.

A voltage of 0.92 times the rated voltage of the ballast shall be applied to the circuit for 30 s. On at least one occasion during this period, the highest pulse voltage (indicated by either of the two voltmeters) shall be not less than the value mentioned in the column 'information for starter design' of the relevant lamp data sheet of IS 2418 (Part 2). If the starter is designed for a range of lamps, care should be taken that the highest voltage value quoted in the sheets for the lamps within that range should be used.

In case of doubt, the measurement with the electrostatic voltmeter is the reference method.

NOTE — As an alternative to the electrostatic voltmeter prescribed in Fig. 1, a memory oscilloscope may be used in the circuit together with a high-voltage probe having the following properties:

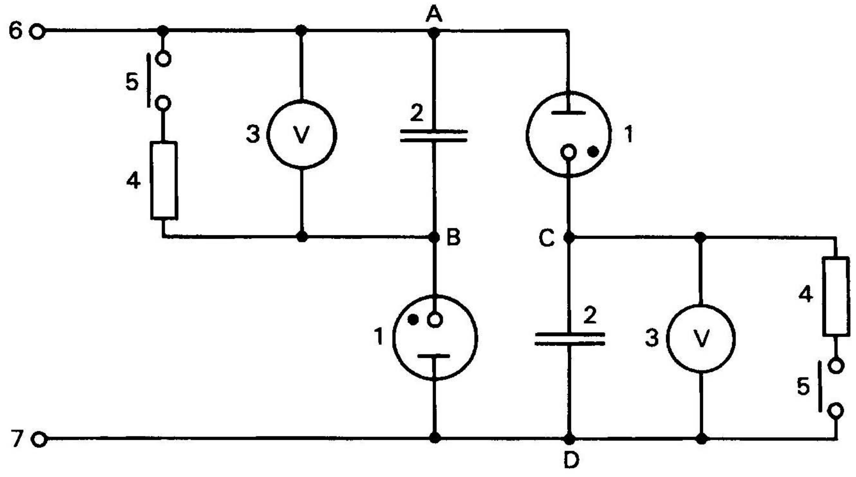
a) Input resistance: : ≥100 MΩ
b) Input capacitance : ≤15 pF
c) Cut-off frequency : ≥1 MHz

7.5 Starters Having an Electronic Switching Element

For explanatory notes and guidance to testing, *see* Annex B.

It may be expected that starters complying with this subclause, when associated with lamps which comply

a) *Circuit diagram*



b) *Components used*

1) HV diode:

Blocking voltage : $U_{RM} \geq 25$ kV
Rated current : $I_{FAVM} \geq 1.5$ mA
Periodical peak current : $I_{FRM} \geq 0.1$ A
Anode/Cathode capacitance : $C_a/k \leq 2$ pF

NOTE — Suitable parts are, for example, HV rectifier tubes type GY 501 for CTV receivers.

2) HV capacitor:

Capacitance : $C = 500$ pF
Rated voltage : $U \geq 6.3$ kV
Phase-angle difference (at 10 kHz) : $\tan \delta = 20 \times 10^{-3}$

3) HV measuring instrument:

Static voltmeter : 0 to 6 kV
Capacitance at full deflection : < 15 pF
Breakdown voltage : > 10 kV
Precision : Class 1 or better

4) Discharge resistance : 1 MΩ

5) Short-circuiting device for discharging

6) To high-voltage lead

7) To neutral conductor

NOTE — The leakage resistance between A and B and between C and D shall be not less than 10^{13} Ω.

FIG. 1 PULSE VOLTAGE MEASUREMENT FOR STARTING DEVICES

with IS 2418 (Part 2) and IS 15687(Part 2) will provide satisfactory starting of the lamp at an air temperature immediately around the lamp between 10°C and 35°C and at voltages within 92 percent and 106 percent of the rated voltage.

For **7.5.1**, **7.5.2** and **7.5.3** compliance is checked with the following:

a) Each lamp cathode replaced by a resistance corresponding to the substitution resistor value prescribed on the relevant lamp data sheet in IS 2418 (Part 2) and IS 15687(Part 2).

b) Supply voltages of 0.92 and 1.06 times the rated voltage of the ballast.

7.5.1 *Speed of Operation*

For starters which incorporate a cut-out, the starter shall operate at least once during the test period of 30 s.

For continuously operating starters, the starter shall operate at least twice during the test period of 30 s.

7.5.2 *Cathode Pre-heating*

The starter shall operate so that the minimum total effective heating current shall comply with the time/current limits specified on the relevant lamp data sheets (*see* Fig. 2).

The absolute minimum pre-heating time shall be at least 0.4 s unless otherwise specified on the relevant lamp data sheet.

The maximum effective heating current shall not exceed the limits specified on the relevant lamp data sheet at any time *t*.

7.5.3 *Open-Circuit Voltage*

The open-circuit voltage between any pairs of substitution resistors representing a lamp shall not exceed the maximum values specified on the lamp data sheet, during the pre-heating period.

After the pre-heating period the voltage shall attain a value, not less than the minimum value for lamp starting, as specified on the lamp data sheet.

If the current through the substitution resistor, as specified in **7.5.2**, is interrupted before the minimum specified voltage for lamp starting has been reached, the voltage rise to minimum starting voltage shall take place within not more than 0.1 s (*see* **B-5**).

If the voltage rise takes more than 0.1 s, the current through the substitution resistor shall not fall below the absolute minimum value specified on the relevant lamp data sheet (*see* **B-5**).

7.6 Non-re-operating Level

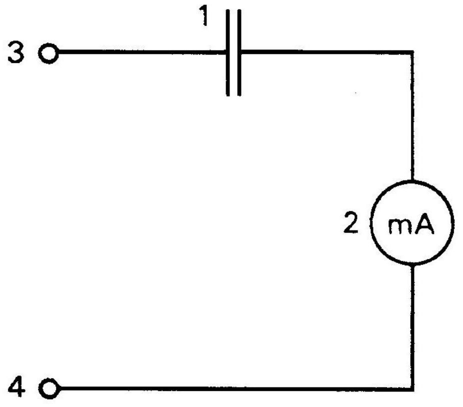
This sub-clause applies to starters with mechanical and electronic switching elements.

With a circuit and ballast as previously specified in **7.3** but with a lamp connected as in normal use the following test shall be applied.

7.6.1 *For Voltage Operated Starters*

A supply voltage equal to the rated voltage of the ballast shall be applied to the circuit, and the lamp shall start and operate normally.

a) *Circuit diagram*



b) *Components used*

1) Blocking capacitor:
   Capacitance : 0.1 µF
   Tolerance on capacitance : ±5 percent
   Rated voltage : ≥1 000 V
   Phase-angle difference (at 10 kHz) : $\tan \delta = 20 \times 10^{-3}$
   Pulse loading capacity : ≥100 V/µs
2) Current measuring instrument suitable for high frequency:
   Current range : 0 to 150 mA
   Indicator error at full deflection : < 3 percent
   Internal resistance of measuring instrument : $R_i \leq 10\ \Omega$
3) To high voltage lead
4) To neutral conductor

FIG. 2 IGNITION ENERGY MEASUREMENT FOR NON-TRIGGERED STARTING DEVICES

After a period of 30 s lamp operation, the supply voltage shall be reduced within 5 s without interruption to 85 percent of the rated value and held in this condition for 90 s. The lamp shall remain alight without disturbance from the starter.

7.6.2 *For Current Operated Starters*

A supply voltage equal to the rated voltage of the ballast shall be applied to the circuit, and the lamp shall start and operate normally.

After a period of 30 s lamp operation the lamp current shall be reduced within 5 s without interruption to a value which shall be 80 percent of the nominal lamp running current as prescribed on the relevant lamp data sheet given in IS 2418 (Part 2). This condition is held for 90 s. The lamp shall remain alight without disturbance from the starter.

7.7 Maximum Pre-heat Current (Lamp Fails to Start)

In order to protect lamp cathodes against excessive pre-heating current, if a healthy lamp fails to start, the following test shall be applied to starters with mechanical and electronic switching elements.

With the starter connected as for normal operation and with a supply voltage equal to 106 percent of the ballast rated voltage applied to the circuit, the total effective heating current through the cathodes during the 60 s period immediately after switch-on shall not exceed 115 percent of the nominal running current of the lamps, as prescribed on the relevant lamp data sheets given in IS 2418 (Part 2) and IS 15687(Part 2).

For this test a deactivated lamp or two separate lamp ends with real cathodes shall be used.

7.8 Interruption of Starter Function

If a manufacturer or responsible vendor declares that the starter has an additional cut-out to disconnect the starter from the circuit, the following test shall be applied.

With the supply voltage equal to the rated voltage of the ballast and with a deactivated cathode lamp or two separate lamp ends with real cathodes, in the place of the lamp, the additional cut-out shall operate within 5 min from the application of the supply voltage to the circuit.

8 ENDURANCE TEST

8.1 Test Quantity

The test quantity shall consist of three starters which have passed the test in accordance with 7.

8.2 Test Conditions

For this test the starters are connected as in normal use, operated at the maximum case temperature t_c and associated with a lamp of the highest wattage rating, for which the starter is intended together with an appropriate ballast. The ballast shall conform to the requirements of Annex A. The test voltage shall be equal to the rated voltage of the ballast.

In the event of the lamp failing during this test, arrangements shall be made for its immediate replacement.

8.3 Starters Replaceable Without Tools

The test duration shall be 6 000 cycles, each of 4 min. During each cycle, the voltage shall be applied to the circuit for 90 ± 30 s.

A rest period of 30 min shall be applied during each 12-h testing.

8.4 Starters not Intended for Replacement

The test duration shall be 25 000 cycles, each of 4 min. During each cycle, the voltage shall be applied to the circuit for 90 ± 30 s.

A rest period of 30 min shall be applied during each 12-h testing.

8.5 Conditions of Acceptance

After this test, the tests described in **7.4** to **7.7** are repeated.

In the event of one starter failing to comply, another three shall be tested, all of which shall comply.

9 DEACTIVATED LAMP TEST

9.1 Test Quantity

The test quantity shall consist of three starters which have passed the test in accordance with 7 but have not been used for the test in accordance with **8**.

9.2 Test Conditions

In this test the starters are connected as in normal use and, except for **9.5**, operated at the maximum case temperature t_c and associated with appropriate lamps having deactivated cathodes. A lamp of the highest wattage rating for which the starter is intended shall be used together with appropriate ballast.

The ballast shall comply with the requirements of Annex A.

The test voltage shall be equal to the rated voltage of the ballast.

It is permissible to use a substitution resistor in place of each lamp cathode. The value of each resistor shall be the objective value as prescribed on the relevant lamp data sheet given in IS 2418 (Part 2).

9.3 Starters with a Mechanical Switching Element but Without Cut-Out

After 3 h continuous operation the starter is subjected to the appropriate tests described in **7.4** to **7.7**.

After a further 5 h continuous operation, neither shall the switching contacts have welded together nor shall the capacitor have failed.

9.4 Starters With an Electronic Switching Element but Without Cut-Out

Starters replaceable without tools shall be subjected after 8 h continuous operation to the appropriate tests described in **7.4** to **7.7**.

Starters not intended for replacement shall be subjected after 40 h continuous operation to the appropriate tests described in **7.4** to **7.7**.

9.5 Starters with a Mechanical Switching Element and with Thermal Cut-Out

Starters are tested in a cycle of 5 min ‘ON’ and 10 min ‘OFF’ at the minimum and maximum temperatures of –20 °C and +80 °C, respectively, unless the manufacturer has specified a different temperature range.

Only the starter is subjected to these temperatures. The lamp and ballast shall remain at room temperature.

During 5 min ‘ON’ period the cut-out shall become operative. Resetting shall not take place by itself.

Starters with manually reset cut-outs shall be subjected 20 times to the test at the minimum temperature and 20 times to the test at the maximum temperature described above.

Starters, whose cut-outs are reset automatically, for example, by actuating the mains switch, shall be subjected 500 times to the test at a minimum temperature and 500 times to the test at the maximum temperature described above.

After this test the starters are subjected to the tests described in **7.4** to **7.7**.

9.6 Starters with an Electronic Switching Element and Electronic Cut-Out

Starters shall be subjected to a test cycle of 4 min. During each cycle the test voltage shall be applied for 90 ± 30 s.

Alternatively, the test cycle may be mutually agreed to between the testing authority and the manufacturer.

The total test cycling period shall consist of at least 500 complete cycles, and the cut-out shall operate during every ‘ON’ period.

At the end of the test cycling period the starters shall be subjected to the appropriate tests given in **7.4** to **7.7**.

9.7 Condition of Acceptance

In the event of one starter failing to comply with the appropriate tests in **9.3** to **9.6**, a further test quantity shall be tested, all of which shall comply. A Guide to quoting product life and failure rate is given for information as in Annex C.

SECTION 3 PERFORMANCE REQUIREMENTS FOR IGNITORS

10 GENERAL

This section specifies performance requirements for ignitors used with low pressure sodium vapour lamps, high pressure sodium vapour lamps and metal halide lamps, and should be used in conjunction with the corresponding standards, if any, for these lamps and their ballasts.

11 STARTING TEST

11.1 The test is made on two ignitors that have not been submitted to any other test.

11.2 Test Conditions

In this test the ignitors are connected as in normal use.

Ignitors are tested in combination with lamps and ballasts for which the ignitor is intended. For ignitors intended for more than one lamp type or lamp wattage ratings it may be necessary to make the test for each lamp type of each wattage rating.

The ballast used shall meet the requirements of the relevant Indian Standard, if any, and be compatible with the lamp type or wattage to be started by the ignitor.

11.3 Conditions of Acceptance

The type complies with the requirements in this section when both ignitors comply with the tests specified in **11.4** to **11.7**.

If one ignitor fails any test, another two ignitors shall be tested and both shall comply.

11.4 Switching Speed

The test is made without a lamp. A voltage of 0.92 times the rated supply voltage is applied to the circuit. During a period of 30 s the starting operation shall take place at least once.

11.5 Pulse Voltage

To measure the pulse voltage the ignitor is connected in accordance with **11.2** but without lamp, using the circuit shown in Fig. 1.

Within the rated temperature range (if any) and with a maximum load capacitance of 1 000 pF (unless otherwise declared by the manufacturer) and at 0.92 times the rated supply voltage, the pulse voltage available at the lamp (generated by ignitor or ignitor-ballast combination) shall be not less than the value declared by the manufacturer.

In case of doubt, the measurement with the electrostatic voltmeter is the reference method.

NOTE — As an alternative to the electrostatic voltmeter prescribed in Fig. 1, a memory oscilloscope may be used in the circuit together with a high-voltage probe having the following properties:

a) Input resistance : ≥100 MΩ
b) Input capacitance : ≤15 pF
c) Cut-off frequency : ≥1 MHz

11.6 Repetition Rate, Pulse Position, Width and Height of Starting Pulse for Triggered Ignitors

Details are under consideration.

The test is made aided by an oscilloscope and a high-voltage probe. Properties required for this combination are:

a) Input resistance : 100 MΩ
b) Input capacitance : 5 pF
c) Cut-off frequency : 50 MHz

11.7 Ignition Energy for Non-triggered Ignitors

The ignition energy of non-triggered ignitors shall be measured in the circuit of Fig. 2. Required values are under consideration.

For ignitors for low-pressure sodium lamps both the circuit and values are under consideration.

12 NON-RE-OPERATING LEVEL

Ignitors shall not operate after the lamp has started.

Two ignitors complying with the test in accordance with **11** shall be subjected to the following test.

A lamp compatible with the ignitor is connected as in normal use, started and operated until stabilized.

For ignitors whose function depends on the lamp voltage the supply voltage is reduced continuously down to 85 percent of the rated supply voltage without breaking the supply circuit.

The current flowing through the ignitor circuit after 1 min shall not exceed the rated lamp current (for ballast protection) and there shall be no disturbance of the lamp function.

For ignitors whose function depends on the lamp current, the lamp current is reduced continuously down to 80 percent of the rated lamp current without breaking the supply circuit.

The current flowing through the ignitor circuit after 1 min shall not exceed the rated lamp current (for ballast protection) and there shall be no disturbance of the lamp function.

This test is not made if, according to the manufacturer, the ignitor, in addition to the starting function, performs other functions necessary for the appropriate operation of the lamp.

However, in case of a defective lamp, the current flowing through the ignitor circuit after 1 min shall not exceed the rated lamp current.

13 ENDURANCE TEST

13.1 Test Quantity

The test quantity shall consist of two ignitors that have passed the tests prescribed in **11** and **12**, as appropriate, and two additional ignitors for the test as specified in **13.2.**

13.2 Test Conditions

In this test the two ignitors are connected as in normal use, each associated with an appropriate ballast. The test voltage shall correspond to 1.06 times the rated supply voltage of the ballast. The ignitors are operated in conformity with their marking at the maximum case temperature t_c and without lamp. In doing so, the live connections of one of the ignitors are loaded by the maximum allowable load capacitance, whilst the connections of the other ignitors are left unloaded.

The ballast used in the life test shall comply with the requirements specified in Annex A. Ballasts that fail during the endurance test are replaced.

Ignitors intended to be connected in series with discharge lamps which could, according to the lamp specification lead to ballast/ignitor overheating, are tested additionally under conditions with maximum case temperature brought to $t_c + X$ °C and with rectifying test circuit in accordance with IS 10322 (Part 1), **13.5** and Annex C.

13.3 Ignitors Without Replaceable Switching Elements

After 30 days (720 h) continuous operation the ignitor shall be subjected to the tests described in **11.4** to **11.7** and **12**.

13.4 Ignitors with Switching Elements Replaceable Without Tools

After 30 days (720 h) continuous operation the ignitor shall be subjected to the tests described in **11.4** to **11.7** and **12**.

Switching elements that fail during this test are replaceable up to six times. The test is regarded as negative when seven switching elements have failed.

After these tests and mounting of any new switching element, the ignitor shall be subjected to the tests described in **11.4** to **11.7** and **12**.

13.5 Ignitors with Additional Cut-Outs

The ignitor is operated at rated supply voltage without lamp, each time at the minimum and maximum temperatures of –20°C and +80°C unless the manufacturer has specified a different temperature range.

The cut-outs shall become operative within 20 min.

Ignitors with manually reset cut-outs shall be subjected 20 times to the test at the minimum temperature and 20 times to the test at the maximum temperature described above.

Starters, whose cut-outs are reset automatically, for example, by actuating the mains switch, shall be subjected 500 times to the test at the minimum temperature and 500 times to the tests at the maximum temperature described above.

After these tests the ignitor shall be subjected to the tests described in **11.4** to **11.7** and **12**.

13.6 Conditions of Compliance

The type complies with the requirements of this section if all ignitors comply with the tests described in **11.4** to **11.7** and **12** after surviving the endurance test according to **13**.

In the event of one ignitor failing to comply, two other ignitors shall be tested, both of which shall comply.

The pulse voltage is measured as in accordance with **11.5** before and after the endurance test. The changes in the value found shall not exceed ±10 percent.

ANNEX A

(*Clauses* 7.3.1, 8.2 *and* 9.2)

BALLASTS TO BE USED FOR LIFE TESTING

A-0 Ballast used for the life testing of starting devices shall comply with the following requirements.

A-1 It shall be of a type that will comply with the requirements of the relevant ballast standard, if any, and correspond with the starting conditions of the lamp.

A-2 When, at its rated voltage, it is associated with a lamp whose voltage at lamp terminals does not deviate by more than ±2 percent from the objective value specified in the relevant lamp standard, the lamp shall dissipate a power which does not differ from its rated value by more than ± 4 percent.

A-3 For lamps with pre-heated cathodes, the pre-heating current (short-circuit current) at rated voltage, shall not differ by more than ±10 percent from the nominal value specified on the relevant lamp data sheet of IS 2418 (Part 2).

A-4 For lamps without pre-heated cathodes, the short-circuit current at rated voltage shall not deviate by more than *X* percent from the value specified in the relative section of IS 15882.

ANNEX B

(*Clause* 7.5)

EXPLANATION OF STARTING CONDITIONS FOR ELECTRONIC STARTERS WITH AN ELECTRONIC SWITCHING ELEMENT

B-1 INTRODUCTION

The requirements for starting conditions given in **7.5** and the associated data given in lamp data sheets in relevant Indian Standard have been specified to encompass the different lamp starting methods which can be employed by electronic starters.

As these starting methods can be more complex than those of conventional glow starter circuits, this annex is provided to assist in the interpretation of the requirements of this standard and of the data specified on lamp data sheets.

B-2 CHARACTERISTICS WHICH AFFECT LAMP STARTING

There are five main physical characteristics which influence the starting mechanism of a fluorescent lamp.

B-2.1 Cathode Heating

Pre-heating current and time of application.

B-2.2 Open-Circuit Voltage

Voltage across the lamp and to the starting aid both during pre-heating and at the moment of lamp ignition.

B-2.3 Environmental Condition

Ambient temperature, relative humidity.

B-2.4 Lamp Physical Conditions

Type of filling gas and its pressure, lamp dimensions, the inclusion of an internal conducting film.

B-2.5 Supply and Luminaire Conditions

Operating frequency, starting aid dimensions and spacing.

All of these characteristics interact with each other in a complex manner and if the correct combination is not obtained for a chosen method of starting, poor lamp performance can result (for example, reduced lamp life, reduced number of starting cycles for a given lamp life, excessive end blackening of the lamp).

B-3 METHODS OF LAMP STARTING (WITH STARTER)

Glow starters, as specified in IS 2215, rely on the closing of bi-metallic contacts caused by the thermal effect of their own gas discharge.

The lamp cathodes pass short-circuit current (that is, the quotient of the open-circuit voltage and the circuit impedance) whenever the glow starter contacts close. This current is approximately saturated due to any significant dc component of the current.

The open-circuit voltage across the lamp, whilst the glow starter contacts are closing, never exceeds the open-circuit voltage of the ballast (often equal to the supply voltage) and this voltage is normally below the level at which glow current, which will damage unheated cathodes, will be induced in the lamp.

The lamp starting voltage is produced in the form of a pulse due to the collapse of magnetic flux in the ballast when the glow starter contacts open; therefore this high voltage across the lamp does not occur until pre-heating current has flowed through the lamp cathodes.

Electronic starters can be designed to provide cathode heating currents and lamp starting voltages in a number of ways, for example, unidirectional current and/or voltage, high-frequency current or voltage, etc.

Because electronic starters can make use of higher technological features, revised methods of specifying, measuring and assessing the starting characteristics often have to be adopted.

The parameters that have to be controlled are the following:

a) Cathode total heating energy; and
b) Voltage across the lamp both before and after the cathode pre-heating period.

The fundamental points which must be observed are as follows:

a) Prior to cathodes reaching emission, open-circuit voltages across the lamp and/or from lamp to starting aid must be kept below the level which causes cathode damaging lamp glow current.
b) After cathodes have reached emission, open-circuit voltages must be adequate to start the lamp quickly and without repeated starting attempts.
c) If open-circuit voltages have to be elevated to achieve lamp starting, once cathodes have reached emission, the transition from low to high open-circuit voltage must occur whilst the cathodes are still at emission temperature.

d) During the cathode pre-heating period the heating current must be adequate to ensure thermal emission; but it must not be so excessive that the emissive material on the cathodes is damaged by overheating.

This latter requirement also applies, if cathode heating currents continue to flow during the lamp starting sequence and for any period after lamp starting has occurred.

B-4 INTERPRETATION OF THE REQUIREMENTS AND INFORMATION GIVEN ON LAMP DATA SHEETS

B-4.1 Minimum Values of Effective Heating Current

The amount of heat necessary to bring a given cathode type to the minimum emission temperature can be stated in terms of time, current and a constant which is determined by the physical properties of that given cathode type.

This relationship can be expressed by the following equation:

$$t_e = \frac{a}{i_k^2 - i_m^2}$$

where

t_e = time to emission (*see* Note) in s;

a = constant for specific cathode type;

i_k = minimum effective heating current necessary to time t_e in A; and

i_m = absolute minimum of effective heating current to achieve emission if application time is of a sufficiently long duration (for example, ≥30 s from cold), in A.

The values of constant 'a' and the absolute minimum current (i_m) are given on each relevant lamp data sheet, together with the values of the cathode substitution resistor.

The minimum value of effective heating current (i_k) can be calculated by substituting the measured value of t_e into the equation given in each lamp data sheet.

NOTE — Emission times less than 0.4 s are normally not acceptable because experience has shown that satisfactory cathode pre-heating is not always achievable in practice.

B-4.2 Maximum Values of Effective Heating

Empirical evidence has shown that a relatively high effective heating current can be applied for a short time (≤ 0.4 s) without cathode damage occurring, but that this high level of current must be progressively reduced for times greater than 0.4 s until, at 2.0 s and longer, the level should not exceed a value which is significantly different from those values already established for 50/60 Hz glow starter circuit practice.

Maximum levels of effective heating current are given on relevant lamp data sheets together with the value of substitution resistor required for the test.

A schematic representation of these requirements is given in Fig. 3.

B-5 OPEN-CIRCUIT VOLTAGES AND TRANSITION TIMES (T_S)

The data in the relevant lamp data sheets is given for systems that require a starting aid and for systems that do not require a starting aid.

It is essential that the correct system is identified before testing commences.

Open-circuit voltages can be generated in many ways, for example, unidirectional pulses, high frequency oscillation, etc. Therefore, care must be taken in evaluating these characteristics with respect to the limiting values specified on lamp data sheets in relevant Indian Standards, if any.

When open-circuit voltages are elevated at time t_e, the time t_s must not exceed 100 ms, if cathode heating is terminated at time t_e.

Transition times of greater than 100 ms are acceptable provided cathodes are kept at emission during the transition time.

As the lamp cathodes will have been brought to emission during time t_e, it is only necessary to ensure that the effective heating current does not fall below the absolute minimum value i_m during the transition/lamp starting phase.

The maximum value of open-circuit voltage prior to time t_e being reached and the minimum value of open-circuit voltage after t_e is reached are specified on the relevant lamp data sheets.

For some lamp types the relevant lamp data sheets may specify values of maximum open-circuit voltage prior to time t_e being reached which are higher than, or the same as, the minimum values of open-circuit voltage specified after time t_e has been reached.

Starters designed for these lamp types do not necessarily have to elevate the open-circuit voltage to start these lamps correctly.

A schematic representation of these requirements is given in Fig. 4 and 5

B-6 MEASUREMENT REQUIREMENTS

As the pre-start and starting characteristics of electronic starters do not necessarily provide steady state sinusoidal voltages and currents, it is necessary to provide measuring devices and techniques which will cope with these conditions.

The term effective heating current has been used to describe the heating effect to time *t* (that is, the total energy to time *t*) and a varying r.m.s. current envelope can be equated to a steady r.m.s. current over the same period by integration of the square of the current.

In many cases it may be possible to deduce from the varying r.m.s. current envelope whether the requirement is met, simply by comparison to the minimum steady state r.m.s. value which will give the same total heating effect. Examples of this technique are given in Fig. 6.

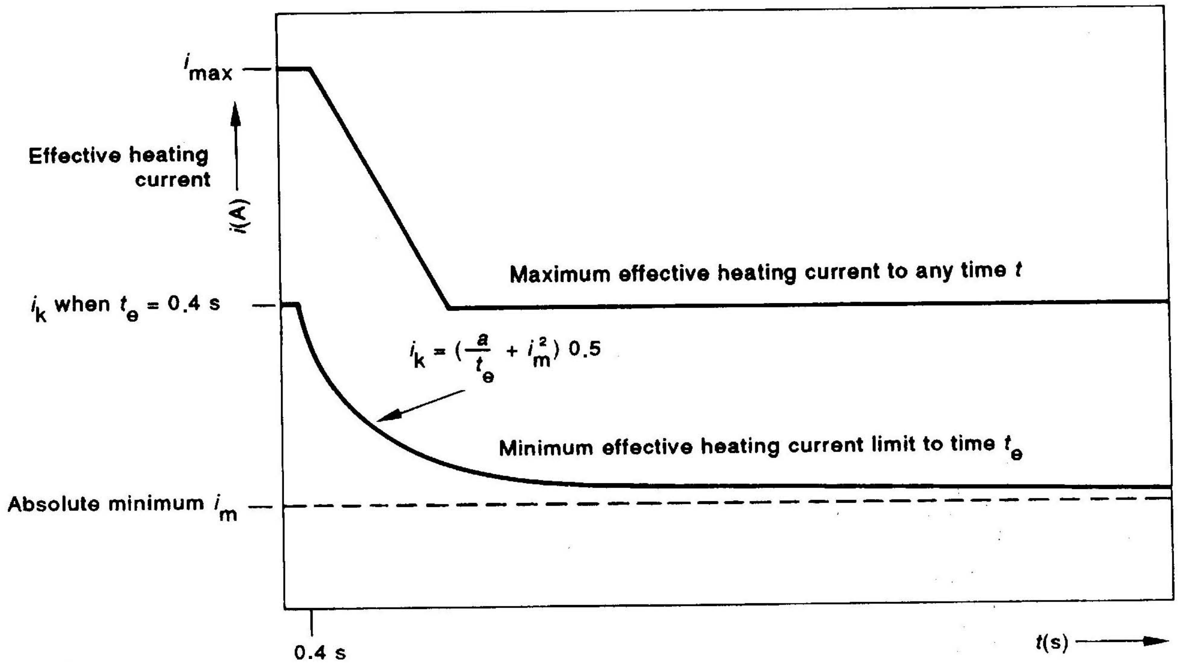

i_{max}
Effective heating current
i(A)
i_k when t_e = 0.4 s
Maximum effective heating current to any time t
$i_k = (\frac{a}{t_e} + i_m^2)\ 0.5$
Minimum effective heating current limit to time t_e
Absolute minimum i_m
0.4 s
t(s)

Fig. 3 Cathode Heating Current Requirements for Electronic Starters with Electronic Switching Element

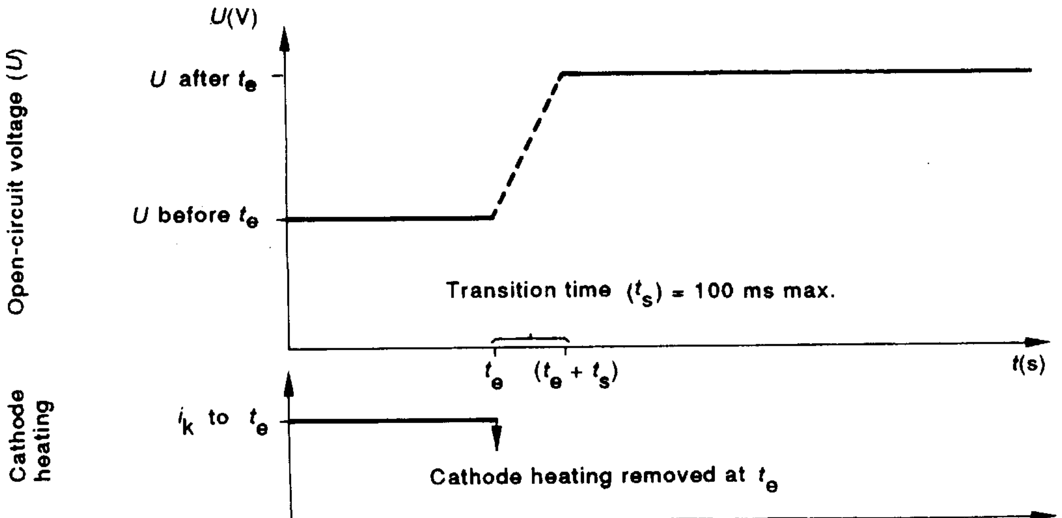


Fig. 4 Starters which Remove Pre-heating Current when Open-Circuit Voltages are Elevated

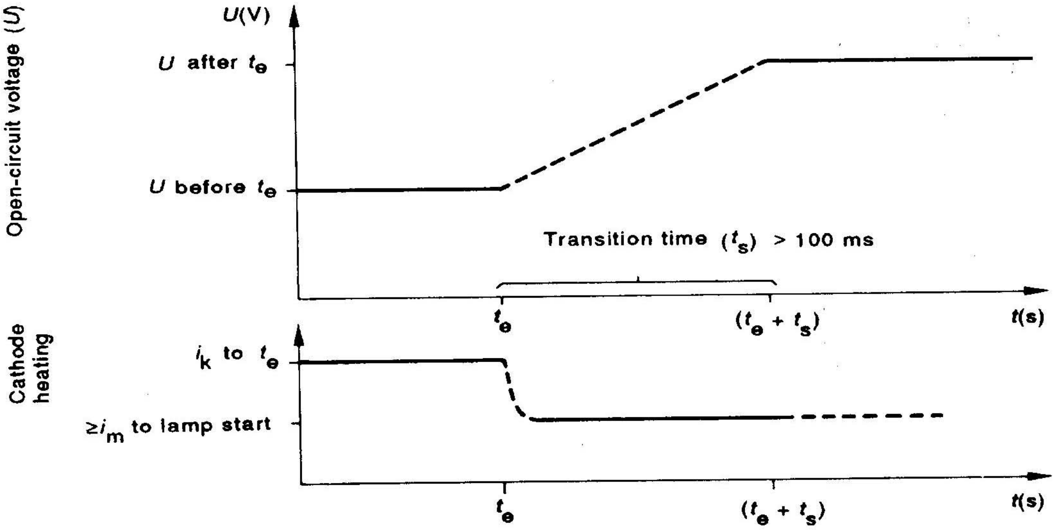
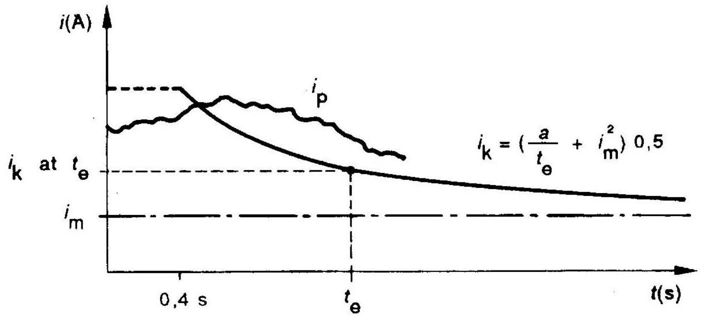


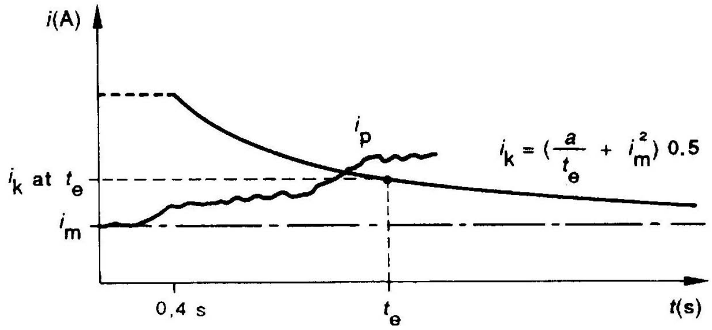
FIG. 5 STARTERS WHICH HAVE OPEN-CIRCUIT VOLTAGE TRANSITION TIMES HIGHER THAN 100 ms



Example 1

Starter complies with **7.5.2**. Varying r.m.s. current i_p never falls below steady state r.m.s. current i_k (at t_e), therefore, the r.m.s. envelope of current i_p can be used to show:

$$\int_0^{t_e} i_k^2 dt > \int_0^{t_e} i_k^2 dt$$

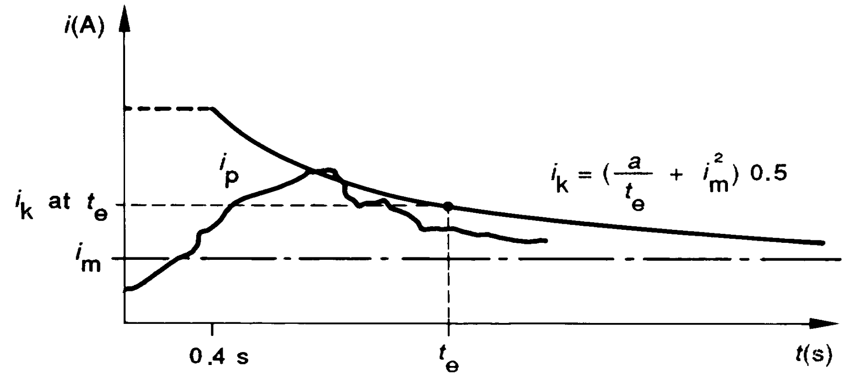


Example 2

Starter does not comply with **7.5.2**. Varying r.m.s. current i_p only reaches the level of steady state r.m.s. current i_k (at t_e), just before time t_e, therefore, the r.m.s. envelope of current i_p can be used to show:

$$\int_0^{t_e} i_k^2 dt < \int_0^{t_e} i_k^2 dt$$

FIG. 6 INTERPRETATION OF EFFECTIVE HEATING CURRENT—*Continued*



Example 3

Starter may or may not comply with **7.5.2**. The varying r.m.s. current i_p only exceeds the steady state r.m.s. current i_k (at t_e) for part of the time period to t_e. Energy measurements or calculations are necessary to determine whether.

$$\int_0^{t_e} i_p^2 \mathrm{d}t < \int_0^{t_e} i_k^2 \mathrm{d}t$$

The total heating effect of the varying heating current to time t_e shall not be less than the equivalent of the steady state r.m.s. current i_k (at t_e) for the same heating effect.

Possible instances are shown in these three examples.

FIG. 6 INTERPRETATION OF EFFECTIVE HEATING CURRENT

B-7 PRECAUTIONS TO BE OBSERVED IF HIGH-FREQUENCY VOLTAGES ARE PRODUCED BY THE ELECTRONIC STARTER

B-7.1 Starting Aid Spacing

High-frequency components in the open-circuit voltage can induce quite high currents to the starting aid during the starting sequence depending on the frequency used. In these cases it is necessary to observe a minimum distance between the lamp and the starting aid to avoid high starting aid currents.

The total heating effect of the varying heating current to time t_e shall not be less than the equivalent of the steady state rms current i_k (at t_e) for the same heating effect.

Possible instances are shown in the three examples in Fig. 6.

ANNEX C

(*Clauses* 9.7 *and* 13.2)

A GUIDE TO QUOTING PRODUCT LIFE AND FAILURE RATE

C-1 To allow the lifetime and failure rate of different electronic products to be meaningfully compared by a user it is recommended that the data given in **C-2** and **C-3** are provided by the manufacturer in a product catalogue.

C-2 The maximum surface temperature, symbol t_l (t – lifetime) of the electronic product or the maximum part temperature which affects product life, measured under normal operating conditions and at the nominal voltage or at the maximum of the rated voltage range, that allows a life of 50 000 h to be achieved.

C-3 The failure rate, if the electronic product is operated continuously at the maximum temperature t_l (*see* in **C-2**). Failure rate should be quoted in units of failure in time (fit).

C-4 For the method used to obtain the information given in **C-2** and **C-3** (mathematical analysis, reliability tests, etc) the manufacturer should, on request, provide a comprehensive data file containing the details of the method.

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